

Poster ID #6 Deep Earth Learning, Training, and Analysis (DELTA) Automating Machine Learning for Earth Science

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Introduction

Machine learning has achieved “human-level” intelligence in tasks ranging from object recognition and speech recognition to mastering the game of Go. However, Earth scientists have yet to fully take advantage of deep learning’s potential. The biggest obstacles are lack of expertise, the high barrier to entry for existing deep learning toolkits, and the intensive computational and data requirements. We are addressing these challenges with DELTA (Deep Earth Learning, Training, and Analysis), a toolkit for Earth scientists and commercial analysts to easily apply deep learning to their own problems.

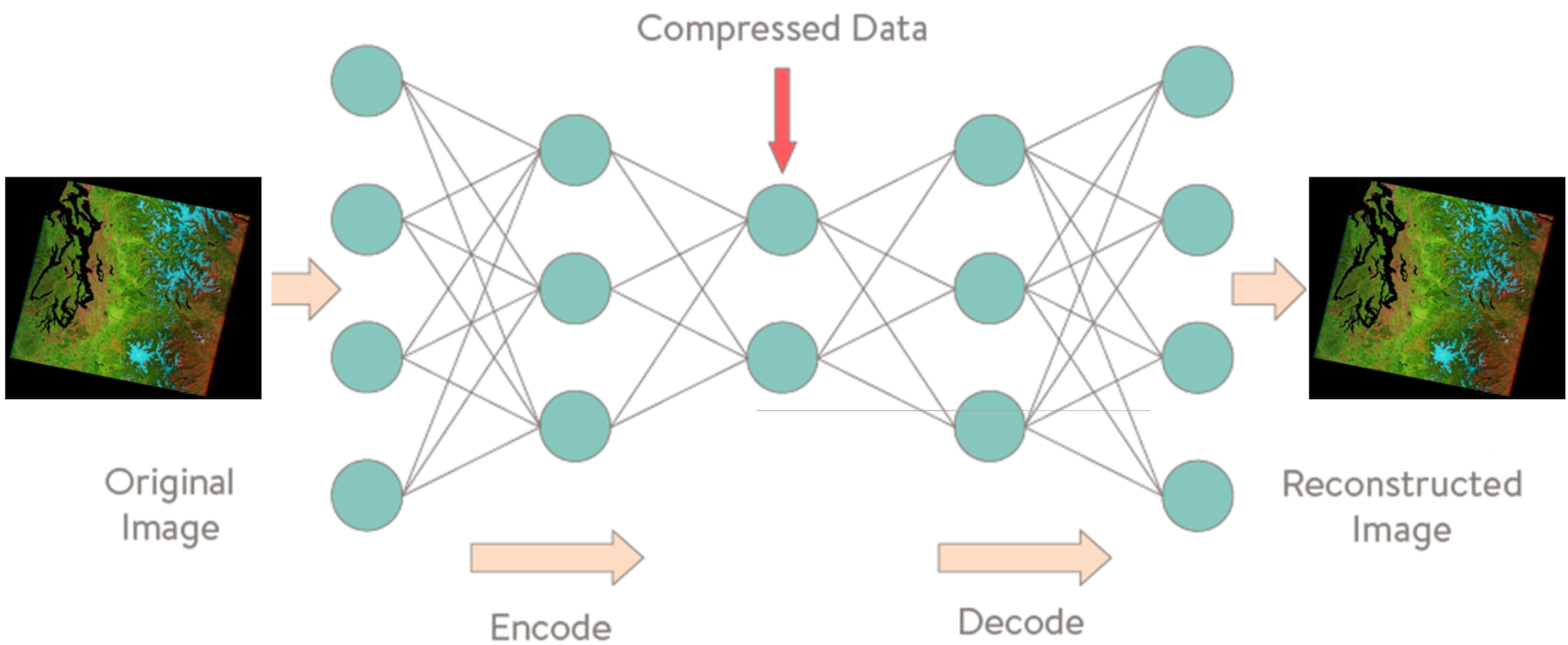
Users only need to provide labeled training data for their problems. DELTA pre-learns useful features for the satellite data sources we are targeting – WorldView, Landsat, and Sentinel-1 -- through large volumes of data on the NASA Pleiades supercomputer. The learned features serve as a starting point to solve users’ specific problems, which can be shared among researchers, amortizing data and computation costs. DELTA then builds task-specific classification networks on top of the learned representations.

We are applying DELTA to mapping flood inundation extent. DELTA will accelerate Earth science research by placing the power of deep learning in the hands of any researcher, achieving “human-level” intelligence in diverse classification tasks which are currently solved manually or with less capable automatic classifiers, drastically expanding the spatial and temporal scales on which many remote sensing problems can be studied.

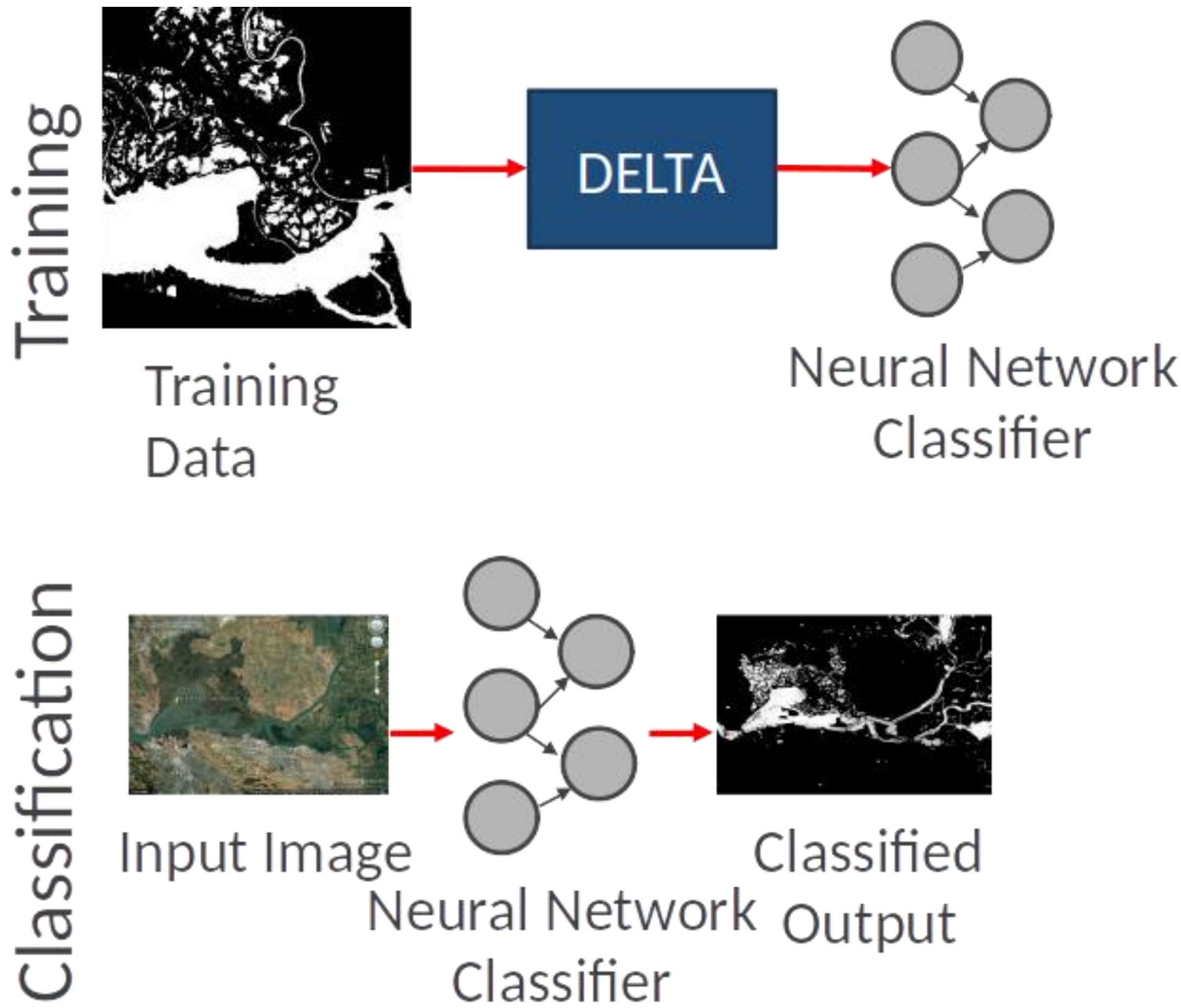
DELTA

- Uses autoencoders to learn features to transform raw satellite data into an informative representation.
- Learns task-specific networks from users' training data, building on the pre-learned features.
- Provides tools for data labeling and visualization of data, natively handles Geotif images.

DELTA is open source and available at <https://github.com/nasa/delta>



Autoencoder: Learn compressed, informative image representation. Different feature sets are learned for our different target satellites, WorldView, LandSat, and Sentinel-1.

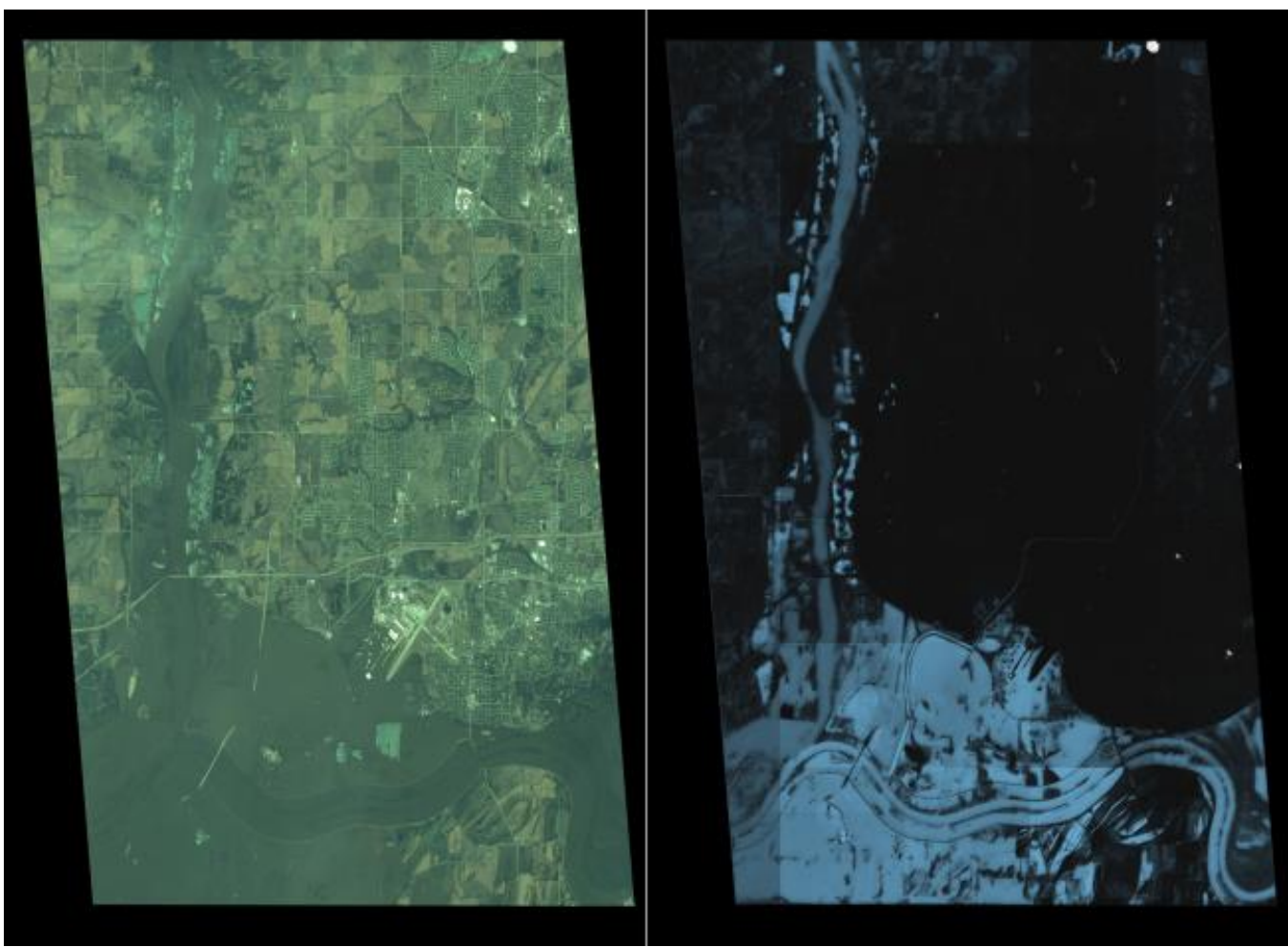


DELTA takes scientists' data and produces a trained neural network. To classify images delta uses the learned network to label new data as part of a larger data processing pipeline.

Results

We have tested our system on Worldview images collected from different flooding events over the past 15 years. Training data was manually annotated by our USGS team members. We trained on 80 images and tested on 20 hold-out images.

| Class | Recall | Precision |
|----------|--------|-----------|
| Water | > 99% | ~83% |
| No Water | ~80% | ~98% |



Left: Input World View flood image (false colour). **Right:** Flood map predicted by DELTA

Acknowledgements

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For more information on our previous flood mapping work, see: *Automatic Boosted Flood Mapping from Satellite Data*. Brian Coltin, Scott McMichael, Trey Smith, and Terrence Fong. International Journal of Remote Sensing, 2016.